CLAIMS

1   1. A method of scheduling operations for logical volumes in a data storage system

2   comprising:

3   determining, for a plurality of priority classes, which operations associated

4   with each of the priority classes in the plurality of priority classes have been requested for

5   a logical volume; and

6   selecting one of the operations by performing a probability-based operations

7   lookup based on the determination.

1   2. The method of claim 1, wherein the probability-based operations lookup comprises

2   using a table of entries corresponding to different operations, further comprising:

3   forming a plurality of first selection values, one corresponding to each of the

4   priority classes in the plurality of priority classes, based on the determination;

5   selecting one of the priority classes in the plurality of priority classes based on

6   the determination; and

7   selecting a corresponding one of the plurality of first selection values

8   corresponding to the selected one of the plurality of priority classes as a lookup index

9   pointing to one of the entries.

1   3. The method of claim 2, wherein the probability-based operations lookup comprises a

2   first lookup level corresponding to a probability-based priority class lookup and a second

3   lookup level corresponding to the probability-based operations lookup, and wherein

4   selecting one of the priority classes in the plurality of priority classes comprises:

5   deriving a second selection value from the first selection values; and

6   using the second selection value as a first lookup index at the first lookup

7   level and using the selected one of the first selection values as an second lookup index at

8   the second lookup level.

1   4. A method of scheduling a requested operation comprising:

2   determining, for a plurality of priority classes, which operations associated

3   with each of the priority classes in the plurality of priority classes have been requested;

4   selecting one of the operations by performing a probability-based operations

5   lookup based on the determination;

6   wherein determining comprises:

7   associating bitmaps with the priority classes, the bitmaps having bits

8   corresponding to available operation types within the priority classes with which the

9   bitmaps are associated;

10   setting the corresponding bits for requested ones of the available operation

11   types in one or more of the bitmaps to produce corresponding class_mask bitmap values;

12   and

13   producing an operation_classes bitmap value from the class_mask bitmap

14   values, the operation_classes bitmap value having a bit for each of the priority classes

15   and set bits for any of the priority classes for which ones of the available operation types

16   were requested.

1   5. The method of claim 4, wherein selecting comprises:

2   selecting one of the priority classes by using the operation_classes bitmap

3   value as a pointer to an entry in a class scheduling table having rows of entries, each of

4   the entries being assigned a single one of the priority classes based on predetermined

5   probabilities associated with combinations of the priority classes.

1   6. The method of claim 5, wherein selecting further comprises:

2   selecting one of the operations for the selected priority class by using the

3   corresponding class_mask bitmap value as a pointer to an entry in an operation

4   scheduling table having rows of entries, each of the entries being assigned a single one of

5   the operations based on predetermined probabilities associated with combinations of the

6   operations.

1   7. The method of claim 6 further comprising:

2   generating a job for the selected one of the operations.

1   8. The method of claim 7, further comprising:

2   determining if the generated job is unsuccessful.

1   9. The method of claim 8, further comprising:

2   selecting a different one of the operations if the generated job is determined to

3   be unsuccessful.

1   10. The method of claim 9, wherein selecting a different one of the operations

2   comprises:

3   clearing the corresponding bit for the selected one of the operations in the

4   associated class_mask bitmap for the selected priority class to produce a modified

5   corresponding class_mask bitmap value, thereby removing the selected one of the

6   operations from further consideration.

1   11. The method of claim 10, wherein selecting a different one of the operations further

2   comprises:

3   producing a new operation_classes bitmap value from the modified

4   corresponding class_mask bitmap value and unmodified ones of the class_mask bitmap

5   values.

1   12. An apparatus for scheduling operations for logical volumes in a data storage system,

2   comprising:

3   a stored computer program in memory instituting the steps of

4   determining, for a plurality of priority classes, which operations associated

5 with each of the priority classes in the plurality of priority classes have been requested for

6 a logical volume; and

7   selecting one of the operations by performing a probability-based operations

8 lookup based on the determination.

1 13. An apparatus for scheduling a requested operation, comprising:

2   determining, for a plurality of priority classes, which operations associated

3 with each of the priority classes in the plurality of priority classes have been requested;

4   selecting one of the operations by performing a probability-based operations

5 lookup based on the determination;

6   wherein the instituted step of determining comprises:

7   associating bitmaps with the priority classes, the bitmaps having bits

8 corresponding to available operation types within the priority classes with which the

9 bitmaps are associated;

10   setting the corresponding bits for requested ones of the available operation

11 types in one or more of the bitmaps to produce corresponding class_mask bitmap values;

12 and

13   producing an operation_classes bitmap value from the class_mask bitmap

14 values, the operation_classes bitmap value having a bit for each of the priority classes

15 and set bits for any of the priority classes for which ones of the available operation types

16 were requested.

1 14. The apparatus of claim 13, wherein the program instituted step of selecting

2 comprises:

3   selecting one of the priority classes by using the operation classes bitmap

4 value as a pointer to an entry in a class scheduling table having rows of entries, each of

5 the entries being assigned a single one of the priority classes based on predetermined

6 probabilities associated with combinations of the priority classes.

1   15. The apparatus of claim 14, wherein the program instituted step of selecting further

2   comprises:

3   selecting one of the operations for the selected priority class by using the

4   corresponding class_mask bitmap value as a pointer to an entry in an operation

5   scheduling table having rows of entries, each of the entries being assigned a single one of

6   the operations based on predetermined probabilities associated with combinations of the

7   operations.

1   16. The apparatus of claim 15, further wherein the program institutes the step of

2   generating a job for the selected one of the operations.

1   17. The apparatus of claim 16, further wherein the program institutes the step of

2   determining if the generated job is unsuccessful.

1   18. The apparatus of claim 17, further wherein the program institutes the step of

2   selecting a different one of the operations of if the generated job is determined to be

3   unsuccessful.

1   19. The apparatus of claim 18, wherein the program instituted step of selecting a

2   different one of the operations comprises:

3   clearing the corresponding bit for the selected one of the operations in the

4   associated class_mask bitmap for the selected priority class to produce a modified

5   corresponding class_mask bitmap value.

1   20. The apparatus of claim 19, wherein the program instituted step of selecting a

2   different one of the operations further comprises:

3   producing a new operation_classes bitmap value from the modified

4   corresponding class_mask bitmap value and unmodified ones of the class_mask bitmap

5   values.